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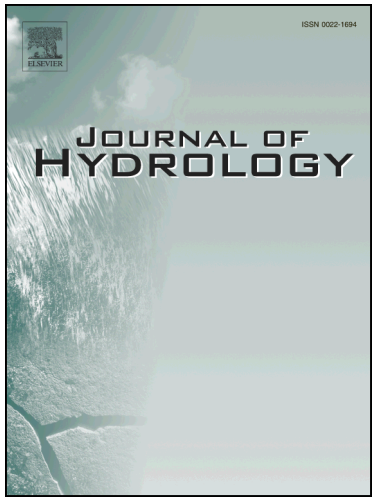

Research papers

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Identifying mismatches between institutional perceptions of water-related risk drivers and water management strategies in three river basin areas

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Abstract

Water-related risks and vulnerabilities are driven by variety of stressors, including climate and land use change, as well as changes in socio-economic positions and political landscapes. Hence, water governance, which addresses risks and vulnerabilities, should target multiple stressors. We analyze the institutional perceptions of the drivers and strategies for managing water-related risks and vulnerabilities in three regionally important river basin areas located in Finland, Mexico, and Laos. Our analysis is based on data gathered through participatory workshops and complemented by qualitative content analysis of relevant policy documents. The identified drivers and proposed risk reduction strategies showed the multidimensionality and context-specificity of water-related risks and vulnerabilities across study areas. Most of the identified drivers were seen to increase risks, but some of the drivers were positive trends, and drivers also included also policy instruments that can both increase or decrease risks. Nevertheless, all perceived drivers were not addressed with suggested risk reduction strategies. In particular, most of the risk reduction strategies were incremental adjustments, although many of the drivers classified as most important were large-scale trends, such as climate change, land use changes and increase in foreign investments. We argue that there is a scale mismatch between the identified drivers and suggested strategies, which questions the opportunity to manage the drivers by single-scale incremental adjustments. Our study suggests that for more sustainable risk and vulnerability reduction, the root causes of water-related risks and vulnerabilities should be addressed through adaptive multi-scale governance that carefully considers the context-specificity and the multidimensionality of the associated drivers and stressors.

Keywords: adaptation; environmental change; global change; multiple stressors; risks; water management

1. Introduction

The impacts of environment-related risks and vulnerabilities are often manifested via water in terms of changes in water quality and quantity (De Souza et al. 2015; Rockström et al. 2014). Furthermore, changes in intensity or frequency of floods and droughts are among the key stressors that cause harmful effects on many communities (Bormann et al. 2012; Eriksen and Lind 2009; Head et al. 2011; Lei et al. 2014; López-i-Gelats et al. 2015).

Earlier research has concentrated on analyzing how single processes or stressors are causing vulnerabilities; however, there has been an increasing number of studies, which evaluate how multiple stressors in interaction with each other affect environment-related vulnerability (Bennett et al. 2015; Räsänen et al. 2016). Several scholars have argued that it is critical to study the severity and the importance of the stressor impacts (Bai et al. 2016; Bennett et al. 2015). The stressors and their relative importance vary according to the context (Tucker et al. 2014) but few have analyzed what are considered to be the most important stressors or drivers in different contexts. In addition, several scholars have argued that the institutional perceptions of the drivers form the basis of adaptation strategies (Eakin et al. 2014; Nyantakyi-Frimpong and Bezner-Kerr 2015; Suckall et al. 2014), but there is little research on the interrelation between perceptions of drivers of water-related risks and strategies of risk management.

To reduce the effects of multiple stressors and drivers of risks, various strategies and adaptive options have been suggested. Because multiple stressors are tightly intertwined

with each other, water governance and adaptation policies and actions should not address them in isolation; thus, it is not enough to consider only a single stressor, such as climate change (Bennett et al. 2015; Eriksen et al. 2011; McCubbin et al. 2015; McDowell and Hess 2012). The relationships between stressors and the strategies to reduce them is not straightforward but complex and multi-scale (Cumming et al. 2013; Folke et al. 2010). For instance, policy instruments themselves can be stressors that increase vulnerabilities, when insufficient attention is given to complex interactions between social and ecological systems (Bose 2015; Bunce et al. 2010a). Overall, few studies have analyzed the multidimensional connection between drivers and strategies.

In this study, we analyze the connections between the institutional perceptions of the water-related risk drivers and risk reduction strategies, and we ask the following research questions: (1) how the key institutional stakeholders perceive the drivers of water-related changes and their importance, and (2) what kind of strategies they propose to address these drivers to reduce the associated risks and vulnerabilities? Furthermore, we discuss if the perceived drivers can be addressed with the help of the suggested strategies. Our analysis focuses on three, regionally important river-basins in countries, with varied socioeconomic and political conditions: Finland, Mexico, and Lao PDR. Our analysis is based on the data gathered through participatory workshops with institutional stakeholders, and complemented with qualitative content analysis of relevant policy documents.

2. Drivers, stressors and strategies

2.1 *Multiple sources of risk and vulnerability and their importance*

Several concepts, such as driver (Connolly-Boutin and Smit 2015), exposure (Bennett et al. 2015) and stressor (McCubbin et al. 2015) have been used interchangeably in studying the effects of multiple stressors on human systems. Although there are considerable interactions between different sources of risk and vulnerability, there are studies in which the importance of different processes has been analyzed (Bunce et al. 2010b; Eakin et al. 2014; Fazey et al. 2011; Feike et al. 2015; Lei et al. 2014; Nyantakyi-Frimpong and Bezner-Kerr 2015; Reid and Vogel 2006; Tschakert 2007). Methods through which the importance of different drivers has been evaluated range from the analysis of local and institutional perceptions to modelling and expert judgment (Räsänen et al. 2016). It has been argued that it is important to understand institutional perceptions of drivers of risk, since institutional views and values constitute the basis of adaptation policies, indicating which factors are considered to have the largest impact in a particular context (Nyantakyi-Frimpong and Bezner-Kerr 2015; Suckall et al. 2014). Perceptions may thus differ from the objectively measured data, but they help in understanding the context and they should be considered when management strategies are planned (Nyantakyi-Frimpong and Bezner-Kerr 2015; Tschakert 2007).

The changes caused by various drivers can be positive, neutral or negative (Fazey et al. 2011; Metcalf et al. 2014); furthermore, it has been argued that the dynamics of drivers of change needs to be analyzed for successful water management (Gillon et al. 2015). Previously, different concepts have been used to denote drivers that cause changes in different directions. For instance, Eakin et al. (2014) differentiate between exogenous

stressors and mitigating factors. Thus, there are different types of drivers and they can range from large-scale trends to local management aspects (Füssel 2007; Hopkins 2015). Here, we use the concept of driver denoting factors that influence changes. One particular type of driver is stressor, which we use in the meaning of a factor that increases stress and risk. Thus, all drivers are not stressors, and drivers can also include management strategies that cause changes in a specific system. In our analysis, we further distinguish between positive and negative trends, with the first decreasing water-related risks and the second increasing those risks.

As with climate projections, there is deep uncertainty on how multiple stressors may influence a specific system in the future (Bunce et al. 2010b; Fazey et al. 2011; Leichenko et al. 2010; Metcalf et al. 2014; Shackleton and Shackleton 2012). The direction of future changes or uncertainty is influenced by the interactions between the drivers: changes in one driver can affect changes in the other drivers and hence the overall changes are difficult to foresee (Bennett et al. 2015; Bunce et al. 2010b; Leichenko et al. 2010; Metcalf et al. 2014; Tucker et al. 2014).

2.2 *Resistance, incremental adjustment and transformation*

In climate change adaptation literature, there is a differentiation between divergent but complementary adaptation strategies to reduce climate change related risks. According to the IPCC (2014), adaptation is a process in which a system adjusts to actual or expected changes, avoids harms and utilizes opportunities. The assessment reports of the IPCC have

reflected a change in focus from a technocratic adjustment with limited attention to the social and political economic dimensions of vulnerability, towards a more reformist approach which more recently includes also some transformative elements and is more appreciative of the multiple dimensions and structural causes of vulnerability (Bassett and Fogelman 2013).

In the IPCC framework, adaptation is closely linked to transformation, which denotes changes in fundamental characteristics of a certain system. Transformation can be considered as a general term denoting large changes in a system or it can be a subcomponent of adaptation; in the latter case, adaptation options can be divided into incremental adaptation and transformational adaptation (Denton et al. 2014). The concept of transformation or transformational adaptation has been criticized as being vague and complex, and it has been used in a variety of meanings. Several criteria for transformational options have been suggested; and for some, they involve normative elements (Klein et al. 2014). According to Béné et al. (2012) transformation is needed when the adaptive capacity of the system is exceeded and transformation can be both deliberate or forced.

Some have further divided adaptation options or resilience strategies into three: resistance, incremental adjustments, and transformation (Matyas and Pelling 2015; Pelling et al. 2015). In this framework, resistance refers to management options that maintain the stability of the system; incremental adjustment to marginal changes or flexibility within the existing system, and transformation to fundamental changes that also implies changes in the existing development trajectory and the dominant relations of power (Table 1). Inside resilience

literature, the term resistance has sometimes been replaced with the concept of persistence which has a slightly different meaning (Béné et al. 2012; Folke et al. 2010; Herrfahrdt-Pähle and Pahl-Wostl 2012).

The political practices related to strategies of resistance, incremental adjustment, and transformation get different meanings and involve different interplays in different contexts (Béné et al. 2012; Hordijk et al. 2014; O'Brien 2012; Pahl-Wostl 2015; Pelling et al. 2015). Examples of such strategies related to governance of water-related risks and vulnerabilities are given in Table 1. We use this conceptual framework for analyzing the risk and vulnerability reduction strategies proposed in participatory workshops and policy documents. Furthermore, we analyze what kind of barriers for these strategies were identified in workshops and documents.

3. Materials and methods

3.1. Study areas

Our analysis focuses on three river basin areas: the River Vantaa basin in southern Finland, a section of the River Grijalva basin in Tabasco, southeastern Mexico, and Lower Xe Bang Fai basin in south-central Lao PDR. These case-study areas are exposed to risks of flooding and inadequate or deteriorating water quality. This selection allows us to better understand the institutional perceptions of the drivers of flooding and water quality, and the risk and vulnerability-reduction strategies considered crucial, in diverse environmental, socio-economic, and political contexts.

The River Vantaa is 100 km long, drains 1686 km^2 and flows through the Helsinki metropolitan area with close to 0.5 million inhabitants in the basin area (Suhonen and Rantakokko 2006). Most the basin is covered with forests, followed by agricultural and residential areas. In the past, the River Vantaa was heavily polluted but after the development of wastewater treatment facilities in the 1970s water quality has improved; nowadays, water quality is considered satisfactory (Niemi 2011; Vahtera and Männynsalo 2015). In addition to water quality problems, there have been floods that have caused economic losses and other socioeconomic problems in the past (Suomalainen et al. 2015).

The study area of Grijalva is composed of the city of Villahermosa and its peri-urban and rural surroundings. Villahermosa with its over 0.5 million inhabitants is situated on the tropical wetlands and traversed by the River Grijalva and the River Carrizal. There are four hydro-power dams operating in the upper-river basin of the River Grijalva. Furthermore, dozens of lagoons within the region have been filled for construction purposes. The overall study area is mostly covered by pastures and agricultural areas followed by urban settlements and natural-like vegetation. Due to its location, the area is exposed to extreme hydro-meteorological events and serious floods have been recorded in Villahermosa since the early 1800s with exceptionally devastating flood occurred in 1999, 2007 and 2008. The 2007 flood affected 1.5 million people and the damage was calculated at US$ 3 billion, equivalent to 30 per cent of the state's gross domestic product (CEPAL 2008).

The study area of Lower Xe Bang Fai basin is predominantly covered by forests, barren land and agricultural areas (mostly rice paddy). Xe Bang Fai River is a major Mekong tributary, and often identified as the rice basket of the country. Its basin hosts more than 250,000 inhabitants (World Bank 2012), which mainly rely on agricultural livelihoods but also on riverine fisheries (Baird et al. 2015). Xe Bang Fai River Basin has been identified as one of the 'flood hotspots' in Laos and the whole Lower Mekong Basin. Recently, a 1070 MW Nam Theun 2 hydropower plant has been built on the Nam Theun River, and the water from the reservoir is released to Xe Bang Fai via a powerhouse and a 27 km downstream channel (Descloux et al. 2014). The dam could potentially be multifunctional but in reality it is operated to maximize electricity production (Baird and Quastel 2015), and 95% of the electricity is exported to Thailand. The power plant is run by Nam Theun 2 Power Company, and the power purchase agreement with the Electricity Generating Authority of Thailand sets the terms for dam operation.

3.2. Methods

3.2.1 Participatory workshops

Participatory approaches have been identified as being especially useful in evaluating different stakeholders' perceptions of change (Fazey et al. 2011), and participatory workshops are particularly valuable in bringing various views together and sharing knowledge (Priess and Hauck 2014). For this study, we organized participatory workshops to gather data on different stakeholders' perceptions of drivers of water-related and risks and vulnerabilities. The workshops were organized on 2 September 2015 in Vantaa, on 22-

23 September 2015 in Grijalva and on 22-23 October 2015 in Xe Bang Fai. We invited participants from different levels of public administration (central, regional, and municipal governments), civil society organizations (CSO) and research institutions to each workshop. There were 15-32 participants in each workshop (20 in Finland, 15-25 in Mexico, and 32 in Laos).

The workshops were organized in cooperation with local institutional partners and with the help of local facilitators, who participated in training sessions prior to the workshops. All workshops were facilitated using local language. In Finland and Mexico, some of the involved researchers participated as collaborative facilitators, while in the case of Laos, the involved researchers used translators to follow the ongoing activities and discussions. Especially in the case of Laos, the discussion was in some important respects restricted. The current government only allows for a limited space to discuss alternative development pathways publicly. Especially on hydropower development discussion is permitted only within the government imposed limits (Matthews 2012). On the other hand, the workshop discussion represented rather well the views of the governmental planning institutions and the approaches allowed for civil society actors.

We modified the methodology of Ravikumar et al. (2014) to focus on water-related changes and aspects of water governance. During the workshops, most of the work was carried out in small groups (5-6 people/group). In the first tasks, groups were divided into homogenous groups (participants were from similar stakeholder groups, e.g. from CSOs or from

environmental administration). In the latter tasks, groups were mixed so that each group had members from different stakeholder groups.

To reflect on the earlier water-related changes, the stakeholder groups first built a timeline indicating what had happened in the study area in the previous 30 years. Thereafter, the groups were requested to identify five drivers of water-related changes that they considered to influence changes in the next 30 years, and to evaluate which kind of influence the changes in the respective drivers will have on water issues. After each group had identified the possible drivers of change, the drivers were compiled into a final list of drivers. After the final list of drivers was drawn, each participant voted for three most important and three most uncertain drivers.

In the second phase of the workshops, participants working in mixed groups outlined the possible changes based on four distinct scenarios, voted on the most desirable and likely scenario, and back-casted how environmental risks and vulnerabilities could be reduced to achieve the most desirable scenario. The participants also listed barriers that hamper the implementation of the planned strategies. In Vantaa, only risk reduction strategies were formulated. We analyzed these risk and vulnerability reduction strategies and their barriers using the conceptual framework of resistance, incremental adjustment and transformation, elaborated in Section 2.

3.2.2 Document analysis

Combination of different methods is crucial for analyzing the multiple processes that affect environmental changes (Feike et al. 2015; Herslund et al. 2015). To evaluate how various drivers are dealt with in the institutional decision making, we analyzed what kind of drivers are mentioned in policy documents and what kind of strategies are suggested for governing the changes. More specifically, we analyzed the themes that were raised as drivers or strategies with methods of qualitative content analysis (Cresswell 2014), focusing on the drivers and strategies discussed in the documents. Document analysis was used both for complementing and comparing the drivers and strategies formulated in the institutional workshops; we thus evaluated if the views and strategies presented in the policy documents differed from those proposed by institutional stakeholders in the participatory workshops. From each study area, we analyzed four to five policy documents related to flood risk and water quality management (Table 2). We selected the most relevant policy documents from each case area and chose them so that different, contextually-relevant aspects of water-related risks and vulnerabilities would be covered. Our main aim was to analyze the overall picture of relevant drivers and strategies presented in the relevant documents of each case-study areas, rather than to carry out a detailed comparison of the specific differences between particular documents. Overall, the documentary analysis helped us to better understand the contextual policy conditions behind the different drivers presented in the workshops. Furthermore, the analysis of both the workshop material and the document analysis data were complemented by the fact that some of the researchers involved in this project had long-term research experience in particular case-study areas included in this study.

4. Results

4.1 Vantaa

In Vantaa, general trends of land use change, population growth due to people's movement near to the metropolitan area, development of agriculture and climate change were identified as the most important drivers (Fig. 1). Of these trends, land use change and population growth were seen as tightly intertwined: when more people migrate to the area, more land is transformed to settlements. Most of the focus in the driver discussion was given to water quality; agricultural diffuse pollution, urban runoff (which is heavily linked to population growth and land use changes) and waste water pollution were all raised as key issues; and agricultural development was further specified with the driver 'effective recycling of nutrients'. Overall, it was expected that climate change, as well as extensification and intensification of the urban settlement will intensify runoff patterns, whereas changes in agricultural practices can decrease nutrient pollution. Other less important drivers were potentially seen to have positive impacts in the future: for instance, it was expected that waste water pollution will decrease and there might be an increase of environmental awareness, as well as positive changes in legislation related to agriculture, waste water, urban runoff and land use. However, participants considered there to be significant uncertainties regarding whether these developments will take place.

In the policy documents, climate change together with tightly interwoven population growth and urban development were seen as major drivers, of which climate change was given most emphasis. Other drivers, such as development of agriculture, wastewater and

urban runoff treatment, flood protection measures, land use planning and transportation were discussed in the policy documents but they were considered either having less importance or being management issues, which were further elaborated in different strategies and policy instruments.

In the workshop, a "radical green scenario" with natural management of the river basin was voted as the most desirable one. Almost all identified drivers were targeted by risk reduction strategies; only population growth, environmental hazards and the economic situation were not discussed but the economic situation was included as a barrier. Some of the strategies included elaboration of a specific driver, such as improved agricultural practices or management of waste water pollution, but for large-scale trends, such as climate change and land use change only adaptation and slight adjustments were suggested. Most of the suggested risk reduction strategies were incremental adjustments, but also some transformative and resistance strategies were proposed (Table 3). Identified barriers included existing administrative boundaries, societal values and problems in institutional co-operation, as well as lack of resources and insufficient norms and regulations.

Many of the strategies identified by the workshop participants were also included in policy documents, but the documents also discussed other management measures. Flood risk management plans proposed a wide variety of flood control measures, and it was acknowledged that both structural measures, such as dikes and bridges, and non-structural measures, such as land use planning and early warning systems were needed. In terms of water quality, the focus was given to reducing nutrient pollution from agriculture, but

improving waste water treatment and urban runoff management were also mentioned. Overall, strategies proposed in the documents can be positioned between resistance and incremental adjustment.

4.2 Grijalva

In Grijalva, climate change, corruption, infrastructure built by the oil industry and public policies were among the drivers perceived as most important (Fig. 2). Large-scale trends included climate change and corruption, policy instruments included reconfiguration of legislation and strategies of water management, whereas some of the drivers, such as environmental culture are difficult to classify into these categories. Many of the drivers were linked to land use changes: drivers such as oil industry infrastructure, land use changes and reforestation can be categorized as trends whereas land use planning, planning for development and urban planning are policy instruments. Almost all the drivers were seen as increasing water-related risks and vulnerabilities in the future. For instance, corruption was seen as a worsening trend, and climate change and the expansion of oil industry infrastructure were also considered to increase the risks in the future. Some drivers, such as reforestation and changes in environmental culture, land use planning and water management were seen as potentially positive trends; however, considerable uncertainties were identified in what kind of changes will happen in water-related policies in the future.

In the policy documents, there were few large scale trends mentioned besides climate change and economic growth. Instead, most of the focus was given to different kinds of management aspects and more local or regional trends, such as the management of dams, classification and management of wetlands, land use planning, urban planning, infrastructure built by the oil industry, risk mapping, relocation of people from high-risk areas, education, unplanned urban expansion, lack of respect for existing land use regulations, and deficient infrastructure to protect the city and canalize water flows.

In the Grijalva workshop, "sustainable and inclusive scenario" was ranked as the most desirable scenario. To achieve a more sustainable future, a mixture of resistance, incremental adjustment and transformative strategies were formulated (Table 4). Most of the perceived drivers were addressed with the suggested strategies, but climate change, reforestation, invasive species and social adaptation were not specifically mentioned. However, identified barriers included resistance to change, which is closely connected to social adaptation. Proposed strategies were often linked to land use changes, limiting population growth (which was mentioned as a driver but accidentally left out of the voting), governance, and flood preparedness strategies which could not be linked to any drivers. Barriers identified in the workshop were related to governance (corruption, insufficient participation, lack of trust, insufficient sanctions, lack of long-term planning), lack of financial resources and skilled workforce, lack of interest in environmental issues, and resistance to change.

In the policy documents, mostly incremental adjustments and resistance strategies were formulated; the most visible transformation strategy was the relocation of settlements from high-risk areas, but the extent and feasibility of it varied between the documents. Integrated water management plans focused on how the hydrology of the river basin will be impacted under extreme events and what kind of new infrastructure and modifications to the current flood prevention system are required to reduce the negative effects of extreme flooding. Some documents also touched on an early warning system, environmental protection, and economic planning at the regional level. In addition to resistance strategies (preparedness, protective infrastructure and technical upgrades), the documents mentioned several incremental adjustment strategies, such as building new urban settlements in low risk areas, rehabilitation of natural areas important for flood control, more careful mapping and monitoring of risk, and more institutional coordination in general.

4.3 Xe Bang Fai

In Xe Bang Fai, drivers related to investments in the primary sector (especially agriculture and mining), climate change and policies for village consolidation, urbanization and natural resources management were considered most important (Fig. 3). At the same time the inequalities related to the distribution of the benefits and costs of the current extractive and concession-based development were not addressed in very detailed way. As in Grijalva, most of the developments were seen as negative in terms of increasing risks and vulnerabilities. For instance, climate change was seen to increase floods and droughts. Only increases in irrigation and education were seen as trends that can potentially decrease risks,

but these changes were perceived as uncertain. The current on-going developments were, however, also seen in positive light: the economy will grow and there will be advancements in infrastructure. Most of the identified drivers were large scale trends, such as climate change, population growth and foreign investments, whereas policies and policy instruments were discussed to much lesser extent. Foreign impact and investments were clearly perceived as influencing many of the ongoing changes; for instance, increasing demand for energy and raw materials is caused in large by foreign actors. Many of the identified drivers were closely related to land use changes, such as village consolidation and urbanization policy, infrastructure development, and development of primary industries such as agriculture, forestry and mining.

A similar pattern of many large-scale trends could be observed in the policy documents, where mostly background trends but also some management aspects were identified. Large scale trends included climate change, land use changes, economic growth, population growth, growth in energy demand, infrastructure and hydropower development and foreign investments. Management aspects and more local trends included irrigation development, fisheries management and wetland management.

In the Xe Bang Fai workshop, the scenario that was regarded as the most desirable aligned for most parts with the current development path with rapid increase in foreign investments, expansion and commercialization of agriculture and on-going deforestation and environmental degradation. However, it was seen as desirable to have much stronger regulation, strict law enforcement and mitigation of environmental degradation. Mostly

incremental adjustment strategies were suggested to achieve this scenario (Table 5). The proposed strategies targeted, at least partly, most of the perceived drivers. Nonetheless, most of the suggested strategies were general recommendations that apply to all policies and plans calling e.g. for more efficient planning and policy implementation, transparency and administrative coordination. Of the perceived drivers, climate change, education, energy demand and population growth were not addressed with the proposed strategies. In the case of energy demand, this is understandable in the sense that one of the main drivers of the hydropower development is not the domestic but the external demand, particularly in Thailand. Barriers identified in the workshop included lack of participation in the decision making process, deficient policy implementation, unfair benefit sharing, lack of education and lack of resources including budget, human resources and capacity.

The policy documents also proposed strategies not mentioned in the workshop. For example, the World Bank documents discussed more in detail measures that would make the construction of hydropower and irrigation infrastructure and other development more environmentally and socially sustainable (e.g. by implementing legal frameworks, safeguards, compensations, fair benefit sharing, and participation of stakeholders). Documents also highlighted positive outcomes of several small-scale infrastructure projects that were planned. The documents also suggested integrated flood mitigation as opposed to structural measures only, although structural measures were given more emphasis. Overall, both resistance to changes and incremental adjustments strategies were proposed in the documents, while the transformative strategies were largely absent.

5. Discussion

5.1 Similarities and differences of perceived drivers

There were considerable differences in terms of perceived drivers between the cases. In Vantaa, many positive (decreasing risks) developments were mentioned, whereas in Grijalva and Xe Bang Fai the focus was mostly on negative (increasing risks) trends. Despite the contextual differences, in all the studied cases, the institutional stakeholders identified important common drivers that will probably increase water-related risks in the foreseeable future. One of these drivers was climate change that was voted to be one of the most important drivers in all cases.

In addition to climate change, stakeholders identified other large-scale drivers that had similar elements across the cases. These drivers were mostly general trends linked to changes in land use and its intensification. Considering the Grijalva case, the impact of infrastructure related to the oil industry was expected to even increase in the future, an expansion of irrigated areas for agriculture will continue and it was expected that the road network will expand (CONAGUA 2012). In Xe Bang Fai, further development in hydropower does not seem to be as likely as elsewhere in the country (as most of the potential has now been developed), but increases of foreign investments in mining, commercial agriculture and forestry are expected (World Bank 2012). This due in part to the willingness of the central government to promote economic growth through increasing foreign investments (Lestrelin et al. 2012). It could be argued that these two larger economic drivers fall outside the sphere of influence of local actors and that they have

limited options to influence the implementation of policy instruments associated to these economic drivers, even if local actors are more likely to bear any increase on water-related risks. In Vantaa, major identified drivers were related to population growth due to migration and closely linked to urban growth (these were considered of lesser importance especially in Xe Bang Fai). There were perceived drivers related to agricultural management and agricultural water pollution, which was not so evident in either of the other two areas.

Overall, land use changes were mostly related to intensification of land use in Finland, whereas expansion of extractive industry in addition to agriculture, was highly evident in Mexico and Laos. Furthermore, foreign investments in the case of Laos drove much of the changes as a least-developed country, whereas in the case of Finland as a highly developed country and Mexico as an emergent economy, national investments were considered as more relevant. These differences can be related both to the specific socioeconomic development of the study areas, as well as to the natural resources available in each area.

Economic drivers were mentioned in all cases. In Vantaa, there was a concern that the current economic situation means less resources to invest on new technologies and municipal projects to improve water quality. In Grijalva, it was considered that the economic situation offers an opportunity to reduce the dependency on the oil sector, and that there might be opportunities to introduce more consistent land-use and urban-planning legislation. At the same time, agricultural intensification will likely promote several land use changes and create new challenges related to water management. For the Xe Bang Fai

region, expanding economic activities driven by foreign investment means potentially more public investment in services (often unevenly distributed). However, the use of state revenues from concessionaires and extractive industries is highly opaque, even in the case of Nam Theun 2. This is despite the World Bank putting great efforts in developing mechanisms to track revenue use (Käkönen and Kaisti 2012; World Bank 2012). There is plenty of research highlighting how in Xe Bang Fai (Baird et al. 2015; Manorom et al. 2017) and elsewhere in the country (Lagerqvist et al. 2014), the current development path fostering hydropower, mining and agricultural plantations has adverse effects on rural livelihoods, including the ones based on riverine resources.

In all the three cases, different drivers related to water governance were raised, but there were significant variations among these drivers. For instance, corruption was regarded as a major driver in Grijalva. According to Transparency International (2015) corruption is an even bigger problem in Laos than in Mexico, but this was not discussed in Xe Bang Fai workshop, probably due to the political sensitivity of the issue. However, it was more indirectly hinted through the strong emphasis put on the importance of transparency. Whereas in Vantaa and Grijalva, water pollution management was raised as a driver, this was less pronounced in the rural Xe Bang Fai, where water quality issues were discussed not in terms of problems of urban waste water but in terms of increased chemical use e.g. in rubber plantations and in terms of water polluting potassium mines. Also the problems related to the flow regime and water quality deterioration due to Nam Theun 2 were brought up (although not as a driver but as an important change in the timeline exercise).

5.2. Differences in proposed risk and vulnerability reduction strategies

In each case, most the risk and vulnerability reduction strategies proposed during the workshops could be categorized as incremental adjustment. Nevertheless, in each workshop, some transformative strategies were formulated. In the studied policy documents, instead, the proposed strategies were either incremental adjustment or resistance. This was expected as the analyzed policy documents represent a highly standardized and compromised view of incumbent government bodies or major development actors. They also proposed changes in rather short term and tended to be less radical than the views given in workshops or interviews. This was particularly clear in Vantaa and Grijalva workshops, where quite radical shifts were formulated in the most desirable scenario. On the other hand, risk and vulnerability reduction strategies proposed in the workshop were not radical and few of them were transformative.

The emphasis on proposing incremental adjustment strategies might suggest a shared idea that these adjustments are small steps forward towards a sustainable path (Pelling et al. 2015), or to the realization that radical transformative strategies are difficult to propose or non-pragmatic in the short run (Sarkki et al. 2016), or even undesirable in some instances. The difficulty of implementing transformation has been discussed in several studies (Béné et al. 2012; Daniell et al. 2014; Hordijk et al. 2014; Houdret et al. 2014; Kates et al. 2012; O'Brien 2012; Pelling et al. 2015); and it has been suggested that back-casting scenarios could help in envisioning sustainability transformations (Sarkki et al. 2016). However, our findings show that there were difficulties in proposing transformational strategies in a back-

casting exercise in an informal situation as well, although a transformational scenario was voted as the most desirable. This might be due to the political sensitivity of water governance, which made it difficult for different stakeholders to propose and agree upon the transformational strategies, especially in the case of Mexico and Laos.

There were considerable differences in the proposed risk reduction strategies between the three cases. In Grijalva, there has been a recent shift from technical flood control measures to more integrated flood-resilience strategies and neoliberal governance with proposals for increased civic self-responsibilization (Nygren 2015; Rinne and Nygren 2015). This major shift was evident also in some of the strategies proposed in the workshop: integrated flood control mechanisms, such as land use planning, territorial reordering and early warning systems were coupled with strategies that emphasized the role of individual responsibilities. Moreover, some of the identified barriers implied the same trend: lack of environmental awareness and resistance to change were considered by some institutional stakeholders as the main obstacles hindering individual action and in this way wider transformation. Surprisingly, although the participating institutional stakeholders indicated in the workshop discussions that they were highly aware of the social segregating forms of flood governance and urban planning in Tabasco as elsewhere in Mexico, they proposed few strategies for transforming the uneven distribution of water-related risks and vulnerabilities, and the involved power relationships, in the workshop. Most of the strategies were based on resistance and incremental adjustments, which reinforce or only slightly alter the existing structures of governance.

In Vantaa, the main focus of the proposed strategies was on improving water quality instead of reducing flood risks. This was especially evident in the strategies related to agricultural management. This is understandable due to the current situation, where most of the pollution in Vantaa is caused by agriculture and other diffuse sources (Niemi 2011; Vahtera and Männynsalo 2015). While water quality improvement is in the core of the future management in Vantaa, it is not the whole picture. Instead, other strategies were suggested and some of them were broad, such as changes in consumption patterns and barriers related to societal values in achieving that change. Furthermore, it was recognized that basin scale planning and objectives are needed to achieve a more sustainable future. There was a desire to transform the current governance system towards more holistic adaptive governance; the shift, which has been already performed in some areas (Schultz et al. 2015). Nevertheless, earlier findings point out that transition towards basin-scale management is not a silver bullet; instead, broader political context, power relations and financial constraints need to be accounted for to achieve a successful transition (Daniell and Barreteau 2014; Hordijk et al. 2014; Houdret et al. 2014).

In Xe Bang Fai, the proposed strategies related principally to the economic development activities happening in the area than directly to water management or governance. These include increase of foreign investments, control of forest degradation and improvements in agriculture. These strategies need to be situated to the context of the area in which large land use changes are happening. These changes have widespread impacts on livelihoods and there have been problems in terms of collaboration and coordination between domestic and foreign actors (Lestrelin et al. 2012; Vongpraseuth and Choi 2015). Thus, it is not

surprising that the suggested strategies also related to governance of resource investments; more coordination, co-operation and transparency and stronger law enforcement were suggested alongside improvement of livelihoods, food security and health care. Although the current development path was recognized to create not only wealth but also vulnerabilities it seems to be considered as something that is either not possible or desirable to fully question or something that is very sensitive and thus risky to question. All in all, the strategies formulated in the Xe Bang Fai workshop were largely less transformative than in the other two workshops although vulnerabilities are more acutely at stake than especially in Vantaa.

There were similarities in the identified barriers of risk and vulnerability reduction. Lack of resources and barriers related to existing forms of governance, especially the lack of participation and insufficient norms and sanctions were mentioned in all workshops. Furthermore, the strategies proposed in each study area showed the multidimensionality of water governance. In other words, water management should be integrated with other policies to mitigate risks and vulnerabilities (Pahl-Wostl 2015; Schultz et al. 2015). Our cases showed that in governing water resources, the siloed management approaches continue to dominate but the main stakeholders often do recognize that integrative strategies are needed in order to address the threats and hazards influenced by multiple drivers and stressors in river basins.

5.3 Complex interplay and mismatch between perceived drivers and proposed strategies

There were similarities and differences between the perceived drivers and proposed strategies. While the list of identified drivers in each workshop included both factors that increase water-related risks and factors that decrease the risk, all the suggested strategies were intended to reduce risks. Therefore, only some of the perceived drivers could be considered as stressors alongside governance barriers, which were also identified in the workshops. Identified drivers included general trends, policy instruments and management strategies, as well as drivers that were not easily classifiable. General trends were mostly negative in terms of risk reduction, although some of them were considered to be possibly positive (e.g. increase in communication in Vantaa, environmental awareness in Grijalva, and education in Xe Bang Fai). Furthermore, it was found that not all policy instruments and strategies reduce risks (Bunce et al. 2010a). For instance, in Grijalva, the perceived driver titled planning for development was seen as negative in terms of water related risks, since only economic development was considered at the moment.

The drivers recognized both in the workshops and in the policy documents act on multiple levels. There are thus interactions across levels, partly affected by inter-institutional and inter-sectoral interplays (Cash et al. 2006; Daniell and Barreteau 2014). For instance, the local manifestations of population growth and economic situation in Vantaa are the consequences in large part of national, European and global policies and trends. Correspondingly, in the case of Grijalva, climate change and land-use changes have complex links to global political-economic processes and inter-state policies. In Xe Bang Fai, the identified drivers of climate change and resource investments relate to global, regional and national levels. Because of the diversity of drivers and their complex

interactions, multi-scale and adaptive governance approaches that are flexible and collaborative, are recommended for effective risk governance (Schultz et al. 2015). This complexity was sometimes indicated in the suggested strategies; for instance, in Grijalva, inter-sectoral policy and planning and development of alternative energy sources and increased independence in energy production were proposed. Yet, by and large these wider-scale trends remained unaddressed.

Hence, we argue that there was an evident mismatch of scales (Daniell and Barreteau 2014; Schlüter and Herrfahrdt-Pähle 2011) between the identified drivers and suggested strategies. This was especially so, when the identified drivers were large-scale trends, including climate change, which was regarded as a highly important driver in all three case-study areas, but also to land use changes caused by population growth (especially in Vantaa but evident also in other areas) and plans for economic development and increase in foreign investments (especially in Grijalva and Xe Bang Fai). The suggested strategies tackled these trends only partially. For instance, in Vantaa, land use changes were proposed to be targeted by rather general and vague strategies, such as basin-scale planning driven by environmental values, but there was little effort in aligning planning with wider environmental and political-economic context. Perhaps this is to be understood in the light of people finding it difficult to discuss measures for processes deemed beyond their control.

Another remarkable scale mismatch was that even if the institutional stakeholders participating at each workshop recognized many relevant water-related drivers that affect a series of risks and vulnerabilities in local communities, the proposed strategies to manage

these problems were mainly national or regional ones. This suggests that the state scale form of water governance and regulation were prioritized, while local resource-users or residents were largely conceptualized as actors unwilling or unable to be politically representative in water governance decision-making. For instance, in Xe Bang Fai, there was little consideration of flood control measures (that mostly are sub-basin and provincial level issues), but it was addressed how national policies e.g. on foreign investments could be made more sustainable. This also exemplifies the need for multi-scale planning, implemented by institutions at various scales and through inter-sectoral networks water to govern related risks and vulnerabilities.

Finally, only a small part of the suggested strategies were transformative. The proposed strategies did not address the root causes of these wider-scale political-economic processes and the power relationships involved. Hence we argue that even if multi-scale forms of governance were developed they would not be enough to respond to most of the changes if only incremental adjustments are developed. In other words, we suggest that scalar considerations do not by themselves necessarily offer the responses needed. For more substantial changes, fundamental transformations are needed in the wider-scale systems of governance and political practices of managing water-related risks and vulnerabilities that carefully consider the politics of water governance and the power relationships involved. Nevertheless, as our data was somewhat limited and we could only touch on scale mismatches, there is a need for both comparative research and in depth-understanding of specific cases in various contexts to further analyze scale mismatches between risk drivers and reduction strategies.

6. Conclusion

We analyzed the institutional perceptions of water-related risk drivers and risk reduction strategies for basins in Finland, Mexico and Laos. We found that there was a scale mismatch between the perceived drivers and proposed strategies: most of the suggested risk reduction strategies were single-scale incremental adjustments, although many of the identified drivers were large-scale trends difficult to manage through such strategies. In the cases of Mexico and Finland there were, however, calls for transformational change towards sustainability, but yet few transformational strategies were proposed and the key institutional stakeholders found it difficult to formulate such policies. We conclude that in order to achieve more transformational changes in water governance, there is a need to scale up the proposed strategies so that they match with the identified drivers. There is also a need for more careful consideration among the involved institutional stakeholders of the inter-institutional and inter-sectoral policy coherence in water governance, as well as of the power relationships involved in water politics and in the social distribution of water-related risks and vulnerabilities.

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Table 1. Different adaptation strategies, some examples related to water governance, and their relative advantages and disadvantages. Drawn with the help of Pelling et al. (2015).

	Resistance	**Incremental adjustment**	**Transformation**
Meaning	Reinforcement of existing infrastructural, institutional and political practices (Pelling et al. 2015)	Marginal changes carried out in the existing infrastructure and institutional and political practices (Béné et al. 2012)	Fundamental changes promoted in the system regime, active search for alternative pathways and political structures (Nygren 2016; Pelling et al. 2015)
Examples	Structural and physical flood-prevention measures, such as levees and dikes (Rinne and Nygren 2015)	Slight modifications in farming techniques (Béné et al. 2012), revisions in land-use planning and water-related legislation (Pelling et al. 2015)	Changes from hierarchical systems of governance to decentralized and participatory forms of water governance (Hordijk et al. 2014)
Pros	Politically relatively easy to implement, enables externally visible investments that promote political legitimacy among the established stakeholders (Nygren 2016; Pelling et al. 2015)	Allows for flexibility and different experiments, enables business-as-usual and re-organization without drastic structural changes (Pelling et al. 2015)	Allows for addressing deep-rooted causes of risks and vulnerabilities and reorientation towards alternative pathways and practices (Pelling et al. 2015)
Cons	Narrows down the governance strategies to the dominant ones, hides	Does not allow for challenges to the underlying values and perceptions that shape systemic	Requires careful consideration of multi-scale governance processes and involved power

the structural vulnerabilities involved in the structures of governance (Nygren 2016; Pelling et al. 2015), limited attention to interlinkages between ecological and social causes of vulnerability (Pahl-Wostl 2015)	vulnerability (Pelling et al. 2015)	relations (Nygren 2016), may promote unexpected social costs in the short term (Pelling et al. 2015).

Table 2. Analyzed policy documents in each study area.

Study area	Reference	Description
Vantaa	(Suhonen and Rantakokko 2006)	Initial flood risk management plan for the whole river basin
Vantaa	(Suomalainen et al. 2015)	Flood risk management plan for Riihimäki hot-spot
Vantaa	(ELY Centre Uusimaa 2010)	Initial flood risk mapping
Vantaa	(Pajunen et al. 2009)	General risk mapping
Vantaa	(Karonen et al. 2015)	Water management plan for a larger area in southern Finland
Grijalva	(CONAGUA 2012)	Integrated Water Management Plan for Tabasco (PHIT)
Grijalva	(Galindo Alcántara et al. 2009)	Atlas of Risk for the Central Municipality in Tabasco
Grijalva	(IMPLAN 2008)	Program of Urban Development for the ity of Villahermosa and Other Urban areas
Grijalva	(CONAGUA 2014)	Final Review for the PROHTAB project
Xe Bang Fai	(Sioudom 2013)	Basin profile document for Xe Bang Fai and other nearby rivers
Xe Bang Fai	(World Bank 2010)	Initial Environmental and Social Examination for Mekong Integrated Water Resources Management Project
Xe Bang Fai	(World Bank 2012)	Project Appraisal Document for Mekong Integrated Water Resources Management Project
Xe Bang Fai	(Mekong River Commission	Lower Mekong Basin Development Strategy

	2011)	
Xe Bang Fai	(Mekong River Commission Secretariat 2009)	Flood risk management plan, including Xe Bang Fai

Table 3. Risk reduction strategies proposed in the Vantaa workshop. Strategies are grouped by the type of the strategy (resistance, incremental adjustment, transformation), what drivers are primarily targeted with the strategy (driver numbers are given in Fig. 1) and how strategies are dealt with in policy documents (grouped into four: not discussed, mentioned, considered proposed).

Type	Strategy	Drivers identified in the workshop	Documents
resistance	renovation of waste water infrastructure	5	proposed
incremental adjustment	basin scale objectives	n.a.	proposed
	adaptation to climate change	4	
	more natural agricultural practices	2	
	restoration of flood areas	10	considered
	diverse agricultural landscapes	2	
	development of legislation	7	
	land use planning considering primarily environmental values	1,8,9	mentioned
	natural tributaries	2,10	
	utilization of waste water to energy production	5	not discussed
	more research and experiments on water management	2,6,10	
	renovation of the agri-environment support system	2	
	recycling of nutrients	6	
	exploitation of positive impacts of climate change	4	
transformation	comprehensive planning on the basin scale	1,8,9,14	not discussed
	changes in consumption patterns	12	

Table 4. Risk and vulnerability reduction strategies proposed in the Grijalva workshop. Strategies are grouped by the type of the strategy (resistance, incremental adjustment, transformation), what drivers are primarily targeted with the strategies (driver numbers are given in Fig. 2) and how they are dealt with in policy documents (grouped into four: not discussed, mentioned, considered and proposed).

Reduction of	Type	Strategy	Drivers identified in the workshop	Documents
Risk	Resistance	Increased control of water resources	13	Proposed
		Elaboration of contingency plans	n.a.	
		Development of early warning systems	n.a.	
		Clean technology	7,13	Considered
		Controlling migration	n.a.	Mentioned
	Incremental adjustment	Establishment of suburban settlements to low risk areas	6,9,12	Proposed
		Development of public transportation	3	
		Governmental support for agroindustry	13	
		Regulation of settlement construction	6,9,12	
		Respect of the norms and standards	2,4	Considered
		New environmental protection laws	4	
		Building awareness on water consumption	5	Mentioned
		Programs for family planning	n.a.	Not discussed
		Creation of well-paid employment	n.a.	
	Transformation	Revision of land-use and urban planning regulations	6,9,12	Considered
		Environmental education and reinforcement of culture of water	5	Mentioned
		Development of alternative energy sources	3	Not discussed
Vulnerability	Resistance	Community brigades for civil protection	n.a.	Considered
		Assistance to affected poulation	n.a.	
	Incremental adjustment	Intersectoral coordination of policies	4,9,10,12	Proposed
		Risk-awareness raising	5	
		Reforming construction regulations	12	
		Strategic planning for sustainable development	4	Considered

	Policies for environmental protection	4,13	
	Transparency in resource management	2,3	Mentioned
	Sexual education	n.a.	Not discussed
	More power to academia	4,9,10,12	
Transformation	Relocation of irregular settlements	6,9,12	Proposed
	Population realignement	6,9,12	
	Territorial reordering	6,9,12	
	Environmental education and culture of water	5	Mentioned
	Energy independence	3	Not discussed

Table 5. Risk and vulnerability reduction strategies proposed in the Xe Bang Fai workshop. Strategies are grouped by the type of the strategy (resistance, incremental adjustment, transformation), what drivers the strategies primarily address (driver numbers are given in Fig. 3) and how strategies are dealt with in policy documents (grouped into four: not discussed, mentioned, considered and proposed).

Reduction of	Type	Strategy	Drivers identified in the workshop	Documents
Risk	incremental adjustment	management of the use of agrochemicals	1,7	proposed
		good governance on infrastructure development	9	
		better co-operation among stakeholders	1,3,9	
		capacity building	1,3,9	
		support organic agriculture	1,7	
		good planning on flood risk control	13,14	
		compensation	1,4,9,12	
		sustainable land use & forest management	5,12	considered
		sustainable development and management plan	1,4,5,9	mentioned
		reducing forest degradation	5	
		better coordination of governance	1,3,9	
		improvement of financial mechanisms	1,3,9	
		policy and regulation enforcement	1,3,9	
		plan on land concessions	1,6,9	
Vulnerability	incremental adjustment	social safeguards	1,4,9	proposed
		capacity & awareness building	1,3,9	
		better coordination of investments	1,4,9	considered
		control of budget flows	1,3	mentioned
		reducing forest degradation	5	
		plan on land concessions	1,6,9	
		ensure food security	6,7,12	
		access to healthcare	n.a.	
		more detailed plans	1,3	not discussed

transformation	participation	1,3,9	considered
	transparency	1,3,9	

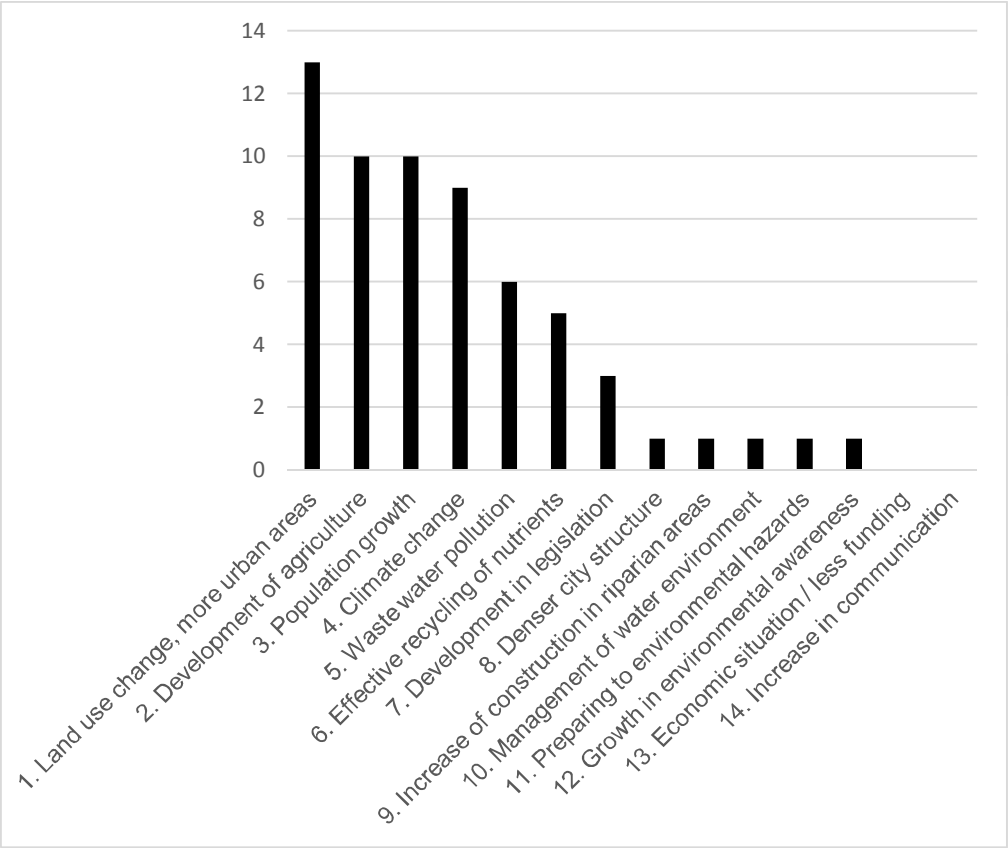

Figure 1. Most important drivers in Vantaanjoki as ranked by the attendants of the participatory workshop. Y-axis values refer to number of votes given in the workshop.

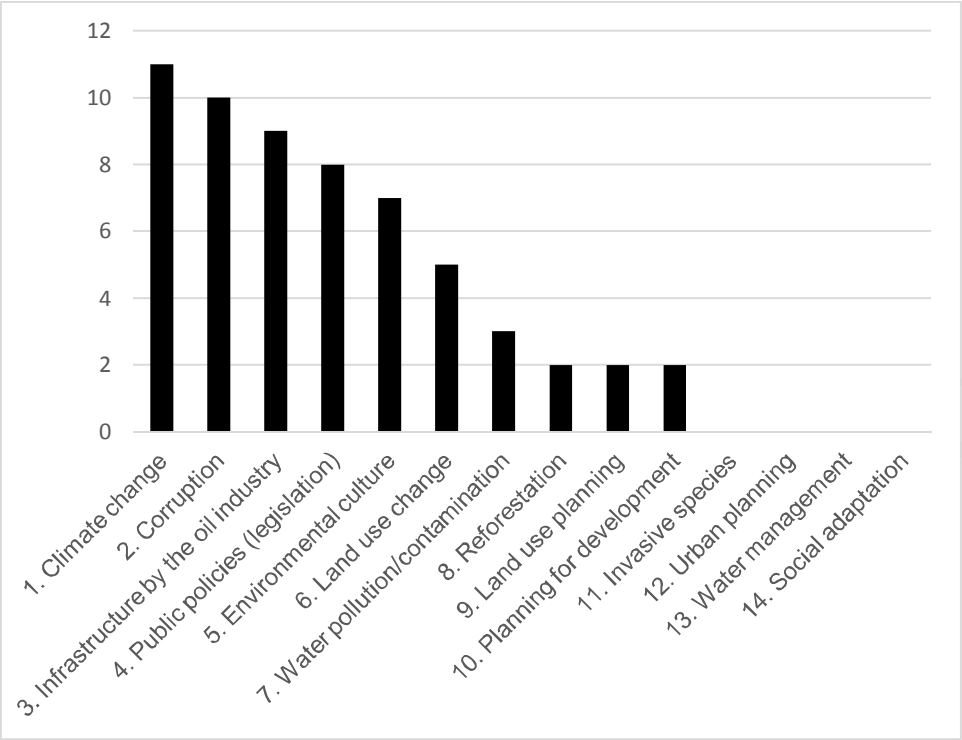

Figure 2. Most important drivers in Grijalva as ranked by the attendants of the participatory workshop. Y-axis values refer to number of votes given in the workshop.

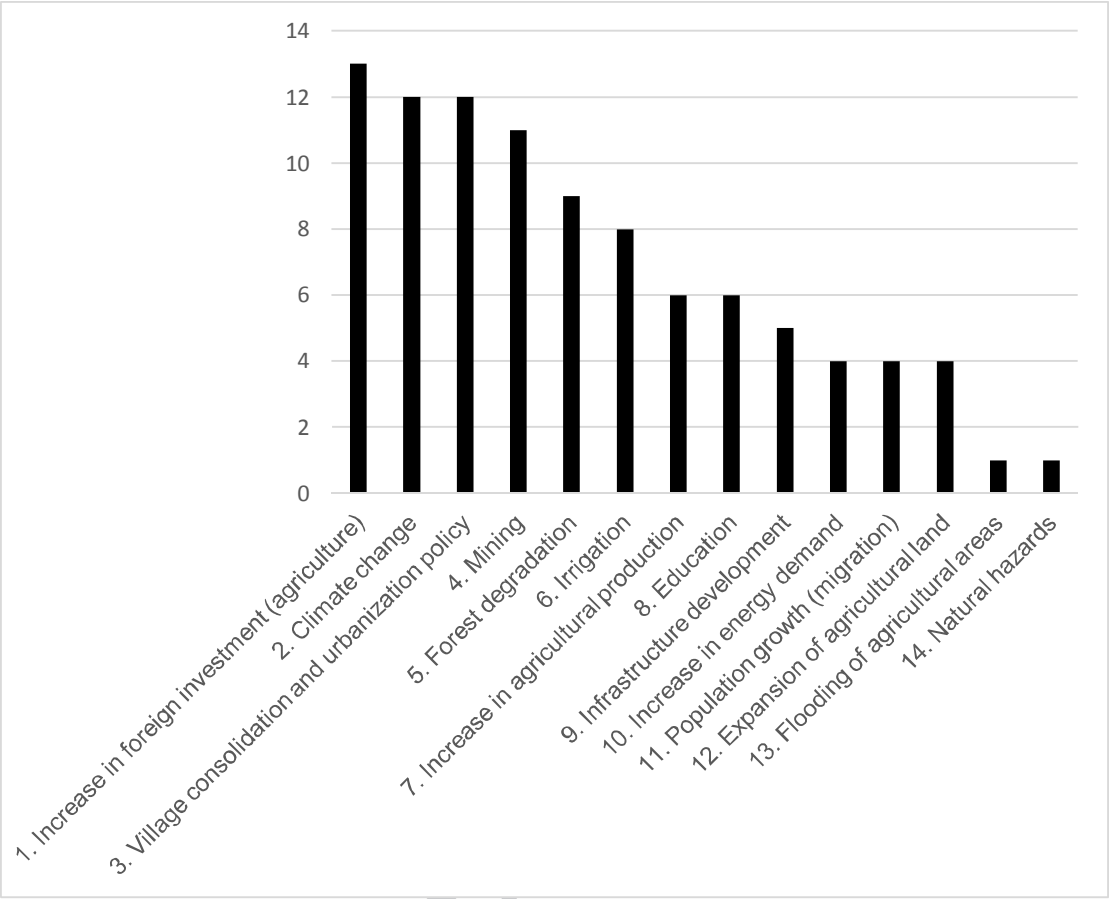

Figure 3. Most important drivers in Xe Bang Fai as ranked by the attendants of the participatory workshop. Y-axis values refer to number of votes given in the workshop.

Highlights

- we analyzed water-related risk drivers and water management strategies
- study areas were basins in Finland, Mexico and Laos
- drivers and strategies showed the multidimensionality of water-related risks
- important drivers were large-scale trends, strategies were incremental adjustments
- there was a mismatch between drivers and strategies